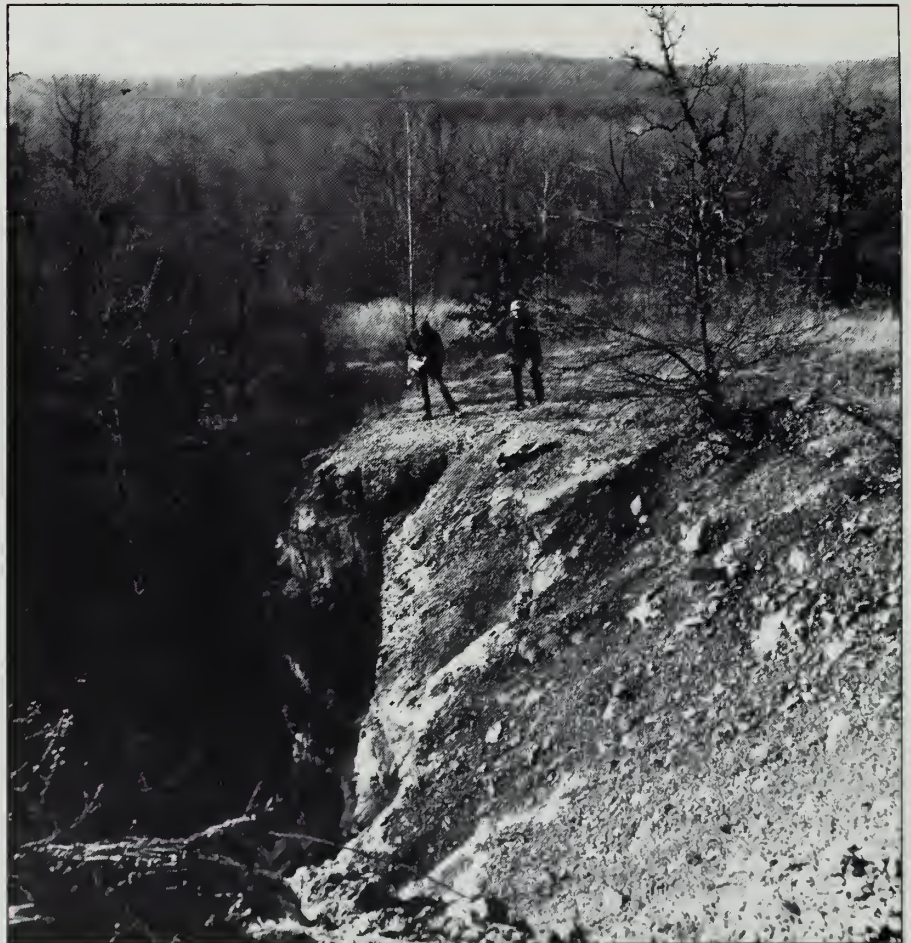
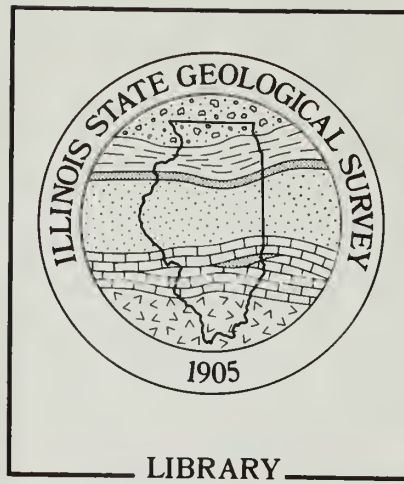


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Geol Survey

Illinois State Geological Survey 1987-88
Highlights of the past and present
A look at the future

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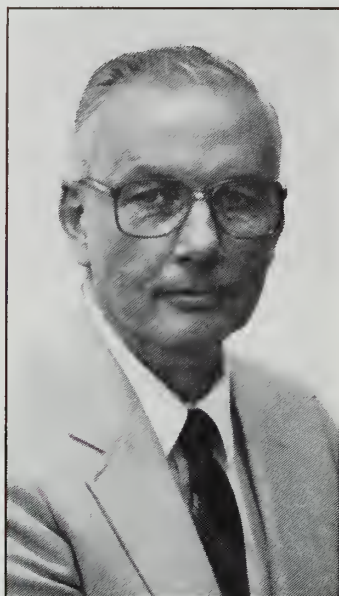


Geologists examine and describe rocks at an abandoned open-cut fluorspar mine in preparation for a Geological Society of America field trip on structural geology of the Shawnee Hills.

Illinois State Geological Survey 1987-88
Highlights of the past and present
A look at the future

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From the Chief



Morris W. Leighton

Scientists at the Illinois State Geological Survey (ISGS) in Champaign have been studying the geology and mineral resources of Illinois and reporting their findings to the public since the ISGS was reestablished in 1905 by the Illinois General Assembly. Our research, service and data collection programs are providing earth science information and ideas focused on strengthening the state's economy and improving the quality of life of Illinois' citizens. We are striving for responsible development and wise use of the state's mineral resources and a better understanding and logical use of our surroundings and their geological environment. The sound scientific information derived from our programs is needed by the State of Illinois to develop valid economic and environmental policies.

Among issues addressed by the Survey's staff are those focusing on energy and minerals—the backbone of the state's economic well being. Through our projects, scientists are seeking ways to increase coal utilization, increase oil recovery and assess mineral potential.... Our efforts are helping to assure a vital resource—water—by locating adequate supplies and pursuing means to protect the supplies from contamination.... With greater demands being made on the state's existing land, ISGS research identifies these resources and delineates appropriate uses.... Agricultural productivity requires our research efforts to protect prime farmlands as well as to provide information on the manner in which farming can coexist with other land uses like mining.... For industrial/urban development, the Survey provides geotechnical information and siting criteria maps to assist with location choices.... And finally, considering risks from natural ha-

zards, ISGS' research efforts identify hazards and recommend mitigation steps for public safety.

Our researchers disseminate information through publications and direct training of other scientists, graduate and undergraduate college students, primary and secondary school teachers and their students, and the general public in laboratories, workshops, classrooms and public meetings across the state. Thus, the ISGS serves both as a state scientific research organization and as an informational and educational institution.

With our legislative mandate as the driving force, the Geological Survey is performing a delicate balancing act: on the one hand, trying to meet the rising public demand for research and services to answer the resource, economic and environmental challenges facing the State of Illinois; on the other hand, obtaining the necessary financial support to effectively carry out these programs. With essentially level funding in recent years, the Survey, a division of the Department of Energy and Natural Resources (ENR), has found its ability to fulfill mandated functions and maintain its world-wide reputation for the quality of its science increasingly difficult. It nevertheless will continue to strive to meet the needs of the people of the state to the best of its ability.

Morris W. Leighton

Purpose of the Survey and Its Present Function

1

Some 54 years prior to the Illinois General Assembly legislating the Illinois State Geological Survey (ISGS) into existence, the General Assembly in 1851 passed a bill providing for a Geological and Mineralogical Survey of the State of Illinois. For the next 20 years, the State Geologist, with a few paleontologists and geologists, performed geological field and laboratory studies throughout the state. Their findings were published as the Geological Survey of Illinois in eight volumes, totaling 4,761 pages of text, figures and plates.

In the legislature's view, the geological survey of the state had been completed in 1875, and for the next 30 years, no state agency was specifically charged with coordinating geological research,

responding to the unique and growing possibilities for development of Illinois' known mineral resources, or locating and identifying new ones.

For those reasons, a petition urging the formation of a State Geological Survey, originating at the February 1, 1905, meeting of the Western Society of Engineers, was sent to the Governor, other state officials, members of the legislature and prominent businessmen. The belief was that the mineral industries needed the foundation a well rounded out geological survey could provide and that the subsequent growth of those industries would many times repay the expenditure for such an institution. Thus, with Governor Charles S. Deneen's support, the General Assembly authorized the establishment of the State Geological Survey at the University of Illinois, July 1, 1905.

The new Survey was charged with four primary responsibilities: to study the geologic formations with respect to products such as coal, ores, clays, building stones, cements, materials for use in the construction of roads, gas, mineral and artesian water, and other mineral sources; to prepare geologic and other necessary maps to illustrate the resources; to prepare reports with illustrations and maps which include both a general and detailed description of the geologic and mineral resources; and to consider other scientific and economic questions of value to the people of Illinois. In carrying out these responsibilities, the Survey was to serve both educational and economic needs of the state.

Throughout the administrations of eight Chiefs, who were initially called Directors (H. Foster Bain; Frank W. DeWolf; T. E. Savage, acting; M. M. Leighton; John



Originated for teachers in 1930, science field trips, sponsored by the ISGS, now include the public and are designed to acquaint participants with the geology, mineral resources and environmental setting of an area. Four trips are offered annually. Those taking the trip, pictured, of the Forrest area in Livingston County, October 1988, study the exposed glacial deposits.



Brachiopods found in limestone along Hutchins Creek are Lower Devonian fossils, about 400 million years old.

C. Frye; Jack A. Simon; Robert E. Bergstrom; and M. W. Leighton), the Survey's research programs have grown in scope and breadth over time, always reflecting the original charges presented to the institution. As industries developed, national emergencies such as the World Wars arose, urban areas spread, and growth opportunities as well as issues presented themselves to the State, the ISGS inaugurated new research efforts to meet and answer these resource, economic and environmental challenges.

Today, the Survey studies and reports on the geology and mineral resources of the state. It conducts research programs on Illinois' mineral resources including coal, oil and gas, strategic and critical minerals, and industrial minerals such as sands, gravels and construction aggregates; on matters related to environmental geology like groundwater resources and groundwater protection, waste management, geological hazards and engineering geology, and land use and land planning; and on those general and basic scientific research areas required

to support and develop the present and future applied research programs.

Through these investigations, the ISGS provides articles and reports, maps, cross sections, data bases, descriptions, analyses, and other data and information on the state's fossil energy and mineral resources; groundwater; land surface, subsurface and underlying structures; and the dynamic processes of the Earth.

The ISGS' basic and applied research programs are conducted to develop a better understanding of the surroundings; to create new ideas and approaches for locating, utilizing or conserving mineral and fuel resources; and to point to new directions to seek answers that will stimulate economic development, solve environmental problems, and assist in policy formulation. By acquiring and managing data, the Survey provides a collection of useful, organized materials, well maintained and readily accessible to support its own informational needs and those of other governmental agencies, the General Assembly, industry and the public. Its role in public service and education is to disseminate information about the geology and the mineral and fuel resources of Illinois, to promote responsible development and use of resources, to protect and enhance the natural environment, and to provide a sound basis for the formulation of policies. For all these purposes, the Survey provides useful services and offers its technological innovations to enable the private, public and governmental sectors in the state to realize the greatest benefit from its scientific endeavors.

Illinois' oil and water drilling records, stored in these files at the Geological Survey, are used by drillers, oil explorers, students, ISGS staff and other governmental personnel as research tools. This valuable resource attracts visitors from across the country.

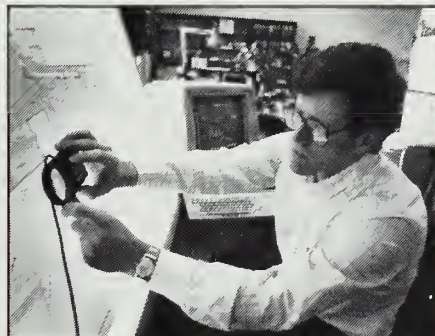


Current Research and Service Projects; Results

3

The Geological Survey's programs of scientific research and service encompass three major areas: 1) Mineral Resources, 2) Environmental and Engineering Geology and 3) General and Basic Research. Subjects covered by Mineral Resources research and service include coal resources and coal desulfurization, oil and gas resources, industrial and metallic mineral resources, and mineral economics.

Coal resource investigations have shown that while most Illinois coal contains an average of 5.0 percent total sulfur, some areas of the state contain coal with a much lower sulfur content. For example, the Hornsby Mining District near Springfield may hold as much as 1.17 billion tons of Herrin (No. 6) Coal, possessing less than 2.5 percent total sulfur. Although the coal deposits in the Hornsby District are thick, lie at moderate depth, and are close to markets and a labor force, they have not been mined because of possible unstable roof conditions. In the Survey's Circular 540, re-



Coordinates and information contained on the underground mine map are being digitized or recorded for storage in the data base files. The information being gleaned for the files is shown on the monitor behind the scientist. The plotter produces a map combining digitized information from a number of sources stored in the Prime computer and uses the computer's Geographic Information System to label and identify data.

leased in early 1988, ISGS scientists compiled available information about the geologic factors that could influence the stability of mine roofs and floors. Evidence suggests that exploratory drilling and detailed geological investigations in advance of mining, coupled with a careful, geologically-based design of supporting structures, could make it possible to safely and economically extract this valuable coal.

New and existing data about mined areas in the state have been digitized and incorporated into the computerized Coal Mine Information System. Using the system, the ISGS has produced an 80-map series detailing mining operations with accompanying directories for 73 coal-bearing counties, useful to mine owners and operators, consulting engineers, planning agencies, real estate developers, insurance companies and property owners.

Oil resource investigations, using new instruments purchased with Build Illinois funds to analyze clay minerals in cores of a petroleum reservoir sandstone, led ISGS scientists to recommend that customary well-completion practices be changed to avoid damaging the reservoir. In addition, Survey petroleum geologists have turned up strong evidence that Silurian pinnacle reefs, some of which are prolific petroleum producers, are much more widespread in Illinois than had previously been thought. New exploration strategies that may improve the chances of finding oil-bearing reefs in these previously unexpected areas are described in a Survey publication, Illinois Petroleum 130.... Another paper, published as Illinois Petroleum 129, focuses on hydrocarbon accumulation in an ancient paleovalley near Hardinville

Oil and gas geologists study Pennsylvanian sandstone core samples as they discuss new ideas about why, how and where the oil industry might pursue promising targets such as sandbars that were deposited across Illinois in a widespread network of ancient valleys about 300 million years ago.



and points to the possibility of many similar oil-bearing sandstone reservoirs in the extensive valley system eroded more than 300 million years ago and buried beneath the coal-bearing rocks of the Pennsylvanian System.

The Survey evaluated possible uses for or disposal of the 4.4 million tons of

ate the 200th anniversary of the U.S. Constitution.

The Survey's Environmental and Engineering Geology programs addressed groundwater resources; groundwater protection; siting assistance, e.g., for industrial plants, the SSC and waste disposal facilities; and natural and man-made hazards, e.g., Lake Michigan, coastal erosion and mine subsidence problems.

To assist communities in their search for new groundwater resources, the ISGS maintains an extensive program. However, limitations of staff and equipment make it impossible to respond rapidly to all requests. Most recently, from groundwater resource investigations, the Survey has produced maps of some shallow aquifers in Kane County that are enabling local officials to increase their water supplies and dilute other supplies obtained from deep bed-rock aquifers containing naturally occurring radium in amounts above allowable limits. In the Danville area, the ISGS' seismic studies, electrical earth resistivity measurements, and other tests have located a shallow aquifer with a potential yield of about 1,000,000 gallons per day, which may be used to augment the city's surface water supplies.

Under the Water Use Act of 1983, persons planning to install a new water well that will withdraw more than 100,000 gallons per day must notify the local Soil and Water Conservation District (SWCD), which may turn to the State Water Survey and the State Geological Survey for technical counsel and advice. The drought of 1988 brought extraordinary demands from districts for the Survey's technical assistance regarding the potential impact on surrounding wells as new wells were installed and existing wells were pumped at unusually high rates to preserve drought-stressed crops.



Survey geologists study the finished 1.25-ton native rock, Illinois' contribution to the new memorial being built in Philadelphia in conjunction with the bicentennial tribute to the U.S. Constitution. The ISGS was asked by the Governor's office to select an appropriate stone, which was located at the McCook Quarry in Cook County. Eleven hours of sawing shaped a five-ton chunk of dolomite, a type of rock which was the "backbone" to the Chicago building stone industry during the 1800s, into the specified four-by-two-by-two-foot block for inclusion in the monument.

limestone and dolomite and .3 million tons of shale, till, and sand and gravel that would have been excavated from the Superconducting Super Collider (SSC) tunnel, if built in Illinois. In addition to storage at active quarries to permit blending and gradual disposal through the market, other alternatives included rebuilding the Kaneville esker to make a county park, landscaping around the SSC, and in-filling of selected quarries or sand and gravel pits.

At the request of the Governor's office, the Survey, through a state-wide search, located a boulder of native dolomite from which a finished block, four feet by two feet by two feet, was produced. This stone will become one of 50 representing the states in a wall to be erected in Philadelphia to commemor-

A major emphasis of ISGS waste management research programs focuses on the development of information useful for preventing groundwater contamination. Since the early 1960s, the Survey has conducted field and laboratory studies of groundwater flow and transport of contaminants, chemical interactions between contaminants and earth materials, and design and construction of improved landfill trench covers. This past year, detailed hydrogeologic evaluations have been completed at 28 waste disposal sites. In fact, the ISGS has conducted basic and applied research directed toward many aspects of the problem of safe disposal of municipal wastes. For example, a recently published state-wide map portrays the regions where shallow aquifers have the greatest to least potential for contamination by land burial of municipal wastes. The map provides a useful tool for regional screening of potential landfill sites.

Survey scientists provide technical assistance and advice to local officials

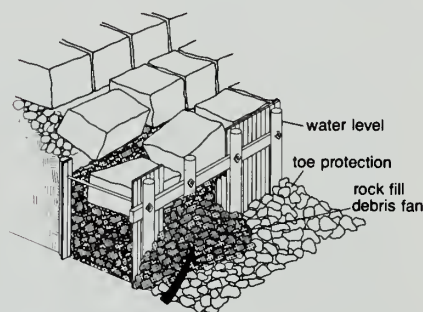
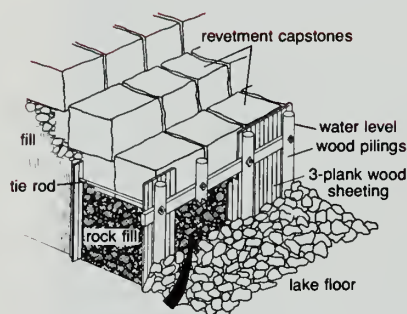
and to the public on the kinds of geological studies needed to properly locate and construct regional waste disposal facilities. Recently, technical advice has been provided for proposed landfill sites in Champaign, McLean and McHenry counties. Because of the large number of requests for information and the Survey's limited staff, sponsored research agreements are commonly necessary. Such agreements generally are developed when more than two days of professional staff assistance are necessary to provide the regional information required to place a proposed landfill site in its proper context and to provide a basis for testing the accuracy of detailed, site-specific geological studies performed by private consulting firms.

Providing siting assistance for the SSC, ISGS scientists compiled an extensive data base from their geological and geotechnical studies. From 1985 through 1988, the Survey directed the drilling of 16,374 feet of exploratory holes, examined and conducted rock strength and other tests on a total of 10,574 feet of bedrock core, compiled downhole geophysical logs and detailed regional seismic profiles, and performed numerous other specialized tasks to meet the federal government's requirements for the SSC site proposal documents and the draft environmental impact statement. The proposal and subsequent documents showed that the site contained no fatal environmental or geotechnical flaws and that the SSC could have been economically constructed in stable, secure, dry bedrock 350 to 500 feet beneath the surface of the ground in Kane and DuPage counties.

Even though the SSC was awarded to Texas, this research effort resulted in Illinois being given an outstanding rating by the U.S. Department of Energy (DOE) on the most important siting criteria,



At Illinois' proposed site for the Superconducting Super Collider (SSC), a Survey geologist measures the interval between the tape mark and natural gamma receivers located along this 8.5-foot sonde. This tool, placed in a borehole, measures the indirect physical properties of earthen materials in a continuous manner while they are in place. Data collected are used to identify distribution of materials and to correlate geologic units in the subsurface.



This model, based on sidescan-sonar studies of damage to Chicago's shoreline protection structures, represents successive stages of deterioration leading to capstone displacement along an idealized revetment with a rock-filled crib. First, the wood piling or wood bulkhead deterioration, breakage and loss provides lakeward exposure of the rock fill. Then, when rock fill is dispersed by wave surge action, gravity and freeze-thaw activity, capstones tilt, slide and fall as underlying support is lost. (From EGN 128.)

geology and tunneling. The State's investment in the research necessary to prepare its proposal for this project has provided a wealth of geological data about northeastern Illinois which will be useful for a multitude of projects for years to come. The extensive base of information will be invaluable for future geology-for-planning studies to screen appropriate sites for new waste management

the lake and past extremes of its levels. Furthermore, the Survey evaluates the performance of various shore-protection structures and analyzes the effects of methods used to mitigate erosion damage and reconstruct eroded beaches, maps geologic features of the lakeshore and lake bottom to provide information important to the development and maintenance of sport fisheries, prepares detailed computer files of data required to produce maps of the shoreline and lake bottom, and maintains a computerized bibliography of more than 5,000 references in scientific literature about research on Lake Michigan.

When lake levels rose to record levels in late 1986 and early 1987, the Illinois shoreline was subjected to unprecedented erosion; many shore-protection structures, especially along the Chicago shore, were severely damaged. Scientists from ISGS served on the Mayor's Shoreline Protection Commission and assisted in the development of the Commission's \$814 million long-term program to rehabilitate and develop Chicagoland's erosion-damaged shoreline.

The Survey's General and Basic Research includes geologic mapping of specific areas in the state, analyzing the history of sediment deposition and the subsidence and uplift of the Illinois Basin, developing chemical and physical analytical techniques, and studying the relationship of Illinois geology to the remainder of the world. Among its numerous programs last year was the preparation of a catalog of the cores that penetrated Devonian and older rocks being stored in the ISGS Geological Samples Library. This project was undertaken to meet the increasing inquiries about these older units for hydrocarbon exploration, use in the storage of natural gas and compressed air energy, and the disposal of liquid hazardous wastes.

facilities, explore for major groundwater resources, or seek the optimal foundation conditions for constructing a new factory. By using such detailed geologic information, county officials, citizens and industries making siting decisions can avoid improper land uses that could cost millions of dollars to correct later.

Since the early 1970s, the Survey has maintained a research and service program to gather data on geologic factors affecting Lake Michigan's shore erosion problems and to offer advice to lakefront communities and property owners on the best ways to combat erosion. In this on-going program, the ISGS measures shore erosion rates and inventories the stability of segments of the shore; examines changes in shore profiles, variations in lake depth, and the dynamics of movement of nearshore sediments; and investigates the geology of the Chicago region to determine the past history of

Ongoing Projects and Solutions Expected

7

Among current Mineral Resource projects is a coal resource assessment, prompted by a National Coal Council report and preliminary findings of the U.S. Geological Survey (USGS), which indicated that available coal resources in the country have been overstated. In a pilot study, various geologic, engineering and environmental factors are being assessed that affect the availability and minability of coal.

In coal desulfurization research, ISGS scientists have developed a proprietary method for hydrating lime with a mixture of alcohol and water that produces hydrates with surface areas three to five times greater than hydrates prepared commercially. (When injected into the combustion chamber of coal-fired boilers, lime hydrates extract sulfur dioxide from the waste gases.) Increased sur-

face areas should improve the efficiency of limes, thus requiring less of the material to remove equivalent quantities of sulfur dioxide and leaving less solid waste for disposal. Tests will be made with the Survey's hydrate in several major flue-gas desulfurization processes this year to learn the economics of the process and determine in which systems the material works most efficiently.

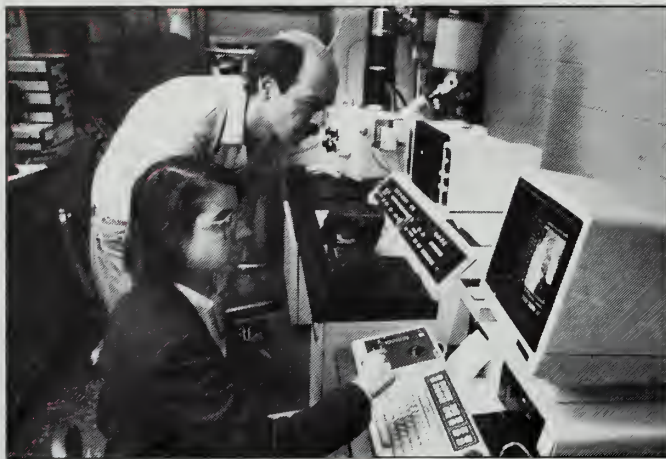
Another project focuses on a mild coal gasification process to produce hydrocarbon liquids and a char that would be acceptable as a boiler fuel or for further gasification.

About one half of the sulfur in Illinois' coals occurs as the mineral pyrite. Extremely fine grinding is necessary to liberate all the pyrite from the coal, but, when this is done, the methods commonly used to wash the pyrite from the coal

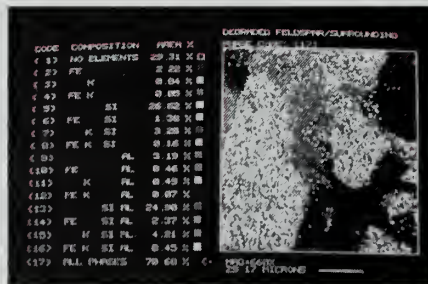
Researchers in the Survey's applied laboratory demonstrate the continuous-flow apparatus used for physical cleaning of finely ground coal. The process, which separates pyrite and ash from the coal, uses surfactants to float off the coal.



no longer work efficiently. Scientists from the ISGS and Southern Illinois University are testing chemicals called surfactants that, in laboratory tests, allow 80 to 90 percent of the ash and pyrite to be removed while recovering 80 percent of the



To improve oil recovery from the Illinois Basin, ISGS scientists are studying heterogeneities (differences in reservoir make-up that affect its capability to release fluids). The new Scanning Electron Microscope (SEM) provides a three-dimensional view of the actual pores of oil reservoir rocks that drilling and completion fluids will contact. Composition of minerals, comprising a reservoir rock, are analyzed using the attached Energy Dispersive Unit (EDU). Up to eight different elements in a sample of reservoir rock will be identified and located on the X-ray map produced on the monitor of the EDU (below). Combinations of elements indicate different clays that will interact with drilling and completion fluids, affecting the flow of oil in or out of the reservoir. By characterizing the reservoirs, the Survey may be able to help match drilling and completion substances with the composition of a reservoir to minimize damage during drilling and thus improve a well's production.



heating value of the finely-ground feed coal. Field studies at a pilot-scale test facility in Homer City, Pennsylvania, show that the aggregate flotation method is technically feasible, but the economics for commercial use have yet to be proven.

Survey scientists also are working to perfect the Carbon Monoxide/Ethanol Coal Desulfurization Process and determine its effectiveness in a continuous-flow reactor. The reactor, designed and soon to be constructed, will test the reaction kinetics and determine engineering factors required for a pilot-scale reactor. Yields of co-products will provide data to carefully analyze the economics of this process.

Although Illinois continues to produce about 24 million barrels of oil each year, about two-thirds of the discovered oil remains trapped within reservoirs. The Survey has initiated a major research program to help Illinois' independent oil and gas producers improve the recovery of oil from known reservoirs. New scientific instruments, acquired through Build Illinois funds, are being used to characterize important physical and chemical attributes of petroleum reservoirs. These data, together with geological information on reservoir heterogeneity (differences in reservoir make-up that affect its capability to release fluids), will be used to develop computer models of fluid flow in reservoirs and to compile an Illinois reservoir atlas to help petroleum engineers design production methods to efficiently extract maximum oil.

Locations of water wells that contain natural gas are being entered in the Geographic Information System (GIS) to generate a map of known gassy aquifers. With this information, water well drillers can take precautions in drilling operations.

More than 250 abandoned limestone and dolomite quarries in seven counties



At Argonne National Laboratory, Survey scientists collect the record of water levels at this monitoring well and take other necessary readings to aid in understanding the site's hydrogeologic character and potential relationships between water-level fluctuations and nearby sources of vibration. During the past year, the Survey determined critical geologic and hydrogeological parameters for preliminary design and construction of the world's most powerful X-ray source, the Advanced Photon Source, at Argonne. The foundation for the positron storage ring must be extremely stable. Its effective operation will depend on its being isolated from vibration, hence the need for the current monitoring program.

of northeastern Illinois have been identified in an on-going survey of the area's aggregate resources.

Turning to Environmental and Engineering Geology, wide-ranging research and service activities are under way related to groundwater protection. These include groundwater monitoring of organic pollutants at Wilsonville to determine the effectiveness of the clean-up operation, studying the persistence of pesticides in loessial soils, developing a plan for statewide monitoring of agricultural chemicals in groundwater, and participating in ENR's educational program on groundwater protection wherein the Survey has helped develop an audio-visual presentation.

Agricultural chemical contamination of shallow groundwater resources is a rapidly emerging issue in Illinois and the nation. The ISGS, in cooperation with University of Illinois and State Water Survey researchers, is conducting several projects designed to assess the extent of contamination in Illinois, improve the understanding of pesticide movement to groundwater, and provide the best available information on contamination potential to individual land-owners. Survey scientists have also provided technical assistance to state and federal agencies in evaluating current programs and in developing regulatory and educational programs.

Through its research program on waste management in Champaign, the Survey is working with the U.S. EPA and the Hazardous Waste Research and Information Center to study the rate at which fluids migrate through earthen liners commonly constructed to seal municipal landfills. The ISGS' fully instrumented, full-scale earthen liner, completed in fiscal year 1988, will be studied for several years with dyes and tracer chemicals to simulate the behav-

ior of real landfills under realistic conditions.

Under the Illinois Mine Subsidence Research Program (IMSRP), coordinated by the ISGS, two panels of coal, soon to be extracted using the longwall mining method, are being instrumented to measure the response of the overlying bedrock and soil to planned mine subsidence. Meanwhile, ISGS scientists are helping characterize mine geology and survey the procedures used to design stable room-and-pillar mines. These are all parts of on-going studies to provide guidelines that will maximize coal extraction while preserving prime farmlands and agricultural production.



Increasingly, contaminated sediments from harbors and navigation channels are being disposed in confined facilities (CDFs) located in Lake Michigan; the possible effects of CDF failure on lake biota is as yet undocumented. It is unknown how much of the organic contaminant occurring in fish is due to diffusion from the water column via contaminated sediments. Survey scientists are investigating the use of membrane bags, pictured, to establish parameters for monitoring the diffusion of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) from the water column into fish.

Channel configuration is measured as part of a study to determine the stability of the river channel along a reach of the Des Plaines River in Lake County where an artificial wetland has been constructed. The ISGS is one of several research institutions monitoring the long-term effects of the wetlands to assess whether simulated wetlands can control flooding and reduce sediments in rivers.

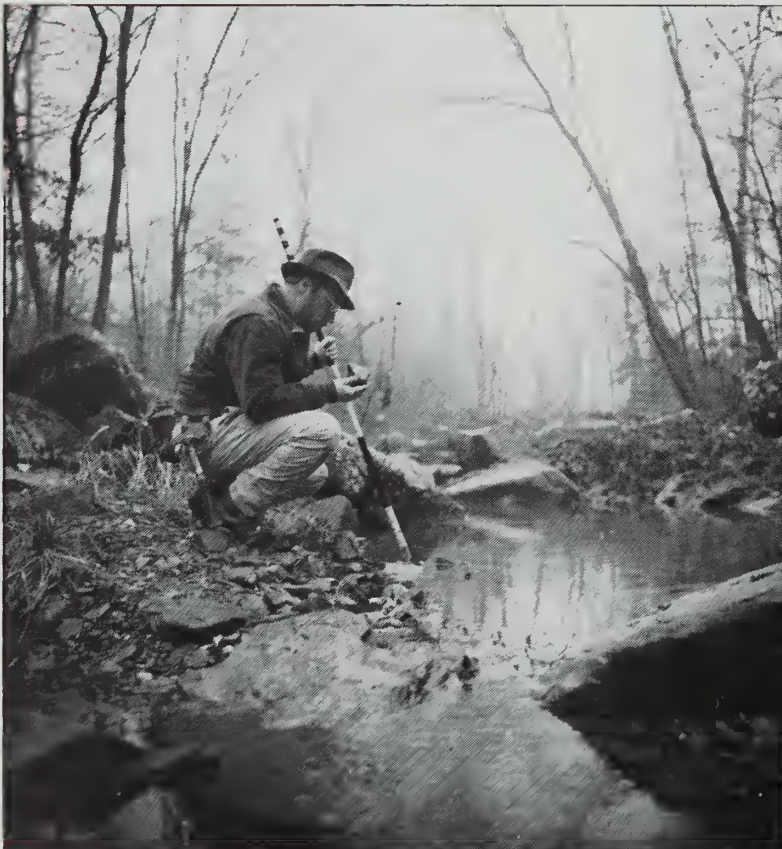


Following completion of a pilot study, scientists from the ISGS and USGS have negotiated a five-year cooperative agreement to conduct research along the shore of Lake Michigan. The USGS Branch of Atlantic Marine Geology has loaned the Geological Survey boats and computerized navigation instruments to expedite bathymetric surveys that provide data to calculate sediment gains and losses of the shore. This information is essential for designing shore-protec-

tion structures such as groins and jetties that control erosion or modify sediment flow. The work includes both marine studies and detailed studies on shore of the record of prehistoric lake levels.

Sediments and soils in and around the Des Plaines River Wetlands Demonstration Project in Lake County have the potential to serve either as sinks or sources for heavy metals in the Des Plaines River. Samples of river sediments and soils are being tested for their tendency to adsorb and release copper, lead and zinc.

Among the numerous General and Basic Research projects is the detailed mapping of the southern closure of the Illinois Basin, which began in 1984 under the Cooperative Geologic Mapping Program (COGEOMAP) of the USGS. Of the 16 quadrangles originally to be mapped, work has been completed or is currently under way on 11. Work has also begun on a state-wide grid of detailed geologic cross sections. Using existing deep drill holes and seismic profiles for control, the ISGS will portray the geology of the state to the Precambrian basement, which at places in the Illinois Basin is as deep as 23,000 feet.



Sometimes creeks align themselves along faults in this particular area of southern Illinois. This geologist reflects on the variety of rocks that have found their way into the creek bed, explaining that fault activity heaved up older structures that stand adjacent to much younger formations, creating interesting time gaps.

Future Projects to Answer Issues Confronting Illinois

11

Future objectives of the Survey's research investigations and service efforts should address anticipated needs and take trends into account. Specific state needs have been identified with respect to the issues of energy, water,



Between the "thumper", a source of energy in the foreground, and recording equipment in the truck further down the street, a Survey employee positions geophones at designated intervals to "listen" to the soundwaves as they bounce off rock formations in the subsurface. The waves create a "picture" of the subsurface that allows hydrogeologists to determine the location of buried bedrock valleys in which water may be found.

minerals, land, agriculture, public safety and public health, information and technology transfer. Within these issues, the following trends are influencing the direction of the Geological Survey's research and service programs:

- Greater concern for the environment and quality of life
- Continuing dependence on groundwater to supply drinking water for about one-half of the population

- Increasing need for groundwater protection
- Increasing recognition of problems from environmental contaminants, pollutants, toxic compounds and elements and radioactive waste materials
- Increasing recognition of the value of geologic mapping for solving and preventing various environmental and land-use problems
- Continuing shortages in domestic crude oil supply and liquid hydrocarbons for transportation, and increasing reliance on foreign sources for liquid hydrocarbons and greater risks to national security
- Increasing need for scale-up, pilot plant operations to test proof of concept
- Increasing needs for commercially viable energy options along with energy conservation
- Increasing dependence on foreign countries for critical and strategic minerals and greater risk to national security
- Increasing needs for quality aggregates, sands and gravels for construction purposes
- Proliferation of data bases of all kinds related to earth science
- Increasing need for selectivity of data sets
- Increasing speed and rate of information dissemination
- Trend toward networking
- Increasing need to add to, update and upgrade data bases
- Increasing recognition of the value of technology transfer
- Increasing need to test and verify hypotheses; hence, increasing need for field studies, drilling etc.

Zeroing in on the future availability of groundwater resources, the Survey will utilize borings, surface geology and available geophysical data to develop a network of cross sections depicting the extent of Quaternary rock units and known aquifers in Illinois and develop maps showing their distribution and



A PC-based Data Acquisition System provides a continuous collection of the stress and strain information from a coal uniaxial compressive test. The stress-strain behavior of coal samples enables scientists to study various mine stability and mine subsidence problems.

reservoir volumes. The ISGS will also carry out hydrogeological investigations of Silurian strata, conduct surface geophysical investigations in priority areas to help locate groundwater resources, and investigate artificial recharge of groundwater areas.

To continue and enhance its long-standing research programs to help protect groundwater resources, the Survey plans to map groundwater recharge areas, establish a groundwater monitoring network, evaluate pesticides in groundwater, and collect and automate groundwater data. Additionally, its scientists will investigate microbial alteration and degradation of pollutants in the subsurface and investigate the behavior of landfill leachates and hazar-

dous and radioactive wastes in naturally occurring materials and settings.

While seeking improved approaches and methods to effectively manage wastes, the ISGS will establish relative risks of Illinois' abandoned and existing landfills, monitor prioritized abandoned landfills for possible groundwater contamination, and expand earthen-liner and trench-cover research.

The Survey's efforts to help establish the availability of Illinois' fossil fuel resources, assess their economic potential, and stimulate incentives to explore and develop them will include determining the availability of coal; identifying oil and gas plays and estimating the remaining hydrocarbon potential; and evaluating the amount of unproduced, recoverable reserves in the existing oil and gas fields. As a part of the effort to assess the remaining hydrocarbon potential, scientists will utilize chemical and physical data on the types and amounts of organic matter and modern methods to predict the stage of maturation of hydrocarbons and the development of oil and gas windows in the subsurface, and extend research on crude oil-source rock correlation to better understand and predict migration paths and hydrocarbon occurrences.

In regard to improving the recovery of liquid hydrocarbons for economic development and national security, ISGS scientists will study the heterogeneity of Illinois oil reservoirs and develop generic models to predict the amount and location of by-passed, unswept mobile oil in existing fields. They will study fluid-rock interactions to determine the causes of formation damage and which stimulation and completion practices work best, where and why; develop better reservoir models; and investigate methods for improving the amount and quality of liquid production from coal.

To improve the utilization of Illinois coal



As part of the Illinois Mine Subsidence Research Program, core is logged, recording the stratigraphy, rock quality, presence of aquifers, and anomalies that would affect its strength. Areas that will potentially be subsided will be cored for this information. Sometimes coring is performed following a subsidence event to observe changes in overburden materials.

for economic development and contribute to the reduction of acid rain and air pollution, the Survey will scale-up operations for the aggregate flotation method of cleaning and the operations for the carbon monoxide/ethanol method of desulfurization and will investigate additional innovative methods for the removal of organic sulfur. In addition, work will be expanded on combustion properties of explosively shattered char and catalytic properties of oxidized char, on uses of char, on efforts to improve the removal of deleterious elements from coal, on economic ways to reduce noxious emissions from coal combustion, and on investigations of environmental impacts of wastes from coal desulfurization processes.

Research efforts to help improve the productivity of Illinois' coal industry and its competitive edge will provide guidelines for maximizing coal extraction while minimizing the impact on prime farm-

land. In addition, scientists will provide counsel and guidance on coal mine designs and mining methods based on geotechnical data and geological observations of heterogeneities that affect coal mining.

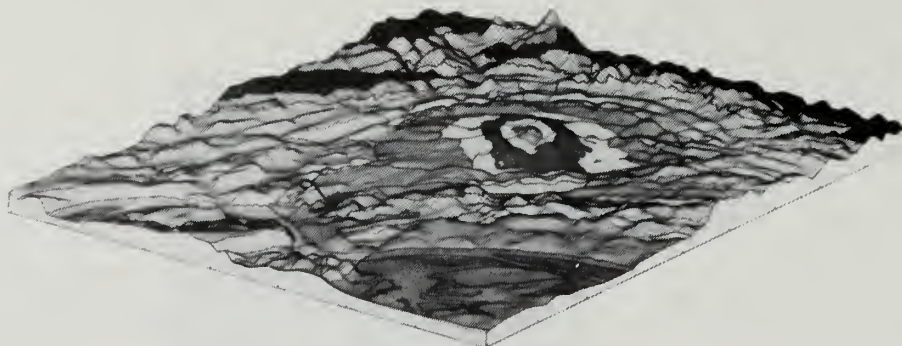
Another Survey goal is to help protect and strengthen Illinois' infrastructure and financial investments in construction and agriculture by avoiding geological hazards or providing guidelines and measures to mitigate the dangers from these hazards. Efforts will be made to assess impacts of mine subsidence on prime farmlands and structures, analyze processes, and seek better means of mitigating damage; undertake risk mapping for mine subsidence; establish landslide risk maps; and investigate the attenuation of seismic waves on earth materials. In that regard, scientists will map the extent of differently behaving materials. This information will be used by consultants and architects to predict earthquake effects and help design earthquake-resistant structures.

Helping to protect the environment and well-being of Illinois' citizens, the ISGS will continue Lake Michigan coastal erosion studies to determine the processes controlling damage to the shoreline and to structures and installations along the shoreline; provide geological and geotechnical data along the Lake Michigan shore, useful in the design of shoreline protection features and beach replenishment; and assist the Water Survey in studies of Lake Peoria.

While helping to revitalize exploration and development of metallic minerals for Illinois' economic development and for reducing U.S. dependence on foreign sources of strategic and critical minerals, the Survey will extend and continue the regional assessment of the mineral resource potential of southern Illinois in cooperation with the USGS and other



With a core, being extracted from a hole at Illinois Beach State Park, Survey geologists will examine Lake Michigan's record of lake-level fluctuations over the past 5,000 years.



This bedrock map of the Hicks Dome region in southeastern Illinois was generated by the Geographic Information System (GIS) for the Conterminous U.S. Mineral Assessment Program's (CUSMAP) pilot study.

state surveys and undertake similar assessments in northwestern Illinois.

Efforts to improve the recovery and reduce the wastage of the state's mineral resources will include further investigations of the processing behavior of coal wastes, seeking improved sand washing procedures, exploring better methods to separate barite and fluorspar, pursuing ways to economically process Hicks Dome ore, and utilizing underground space created by mining operations.



Scientists study seismic lines, which provide valuable information on subsurface structure.

To strengthen the state's infrastructure and economy by identifying economically viable sources of construction aggregates and sands and gravels, the scientists will conduct an inventory of aggregate resources near rapidly urbanizing areas, characterize limestone mines for possible future underground resources of aggregates, map the extent of non-calcareous gravels in northwestern Illinois, and investigate the distribution and occurrence of siliceous materials.

Other endeavors will help expand tourism and recreational facilities with appropriate geological and educational contributions, expand the basic understanding of the state's geological surroundings and earth processes, and strengthen its position as one of the nation's leaders in technological innovation and research. In addition, efforts will be made to enhance the ISGS' data base of useful information for exploring, developing and utilizing the state's fuel and mineral resources; for locating and protecting its groundwater resources; for protecting the environment; for identifying hazards and protecting the well-being of its citizens; and for reducing the financial risk to its installations and infrastructures.

Plans also call for efforts to help improve ISGS and State planning, decision making, and policy formulating ability with appropriate economic studies of Illinois' mineral resources. Furthermore, the Survey plans to provide useful and rapid means for the transfer of technology to the private and public sectors.

Of course, the ISGS's ability to carry out these research and service endeavors will depend on its capability to ensure salary levels that will both retain and attract qualified staff; ensure an adequate budget for operating line items to enable the staff to meet program obligations, achieve recognition, and maintain state-of-the-art readiness; and provide adequate space and facilities to enable the staff to work effectively and efficiently. The Survey will also need to be properly equipped to carry out its mandates and programs of research and to attract and retain quality staff. And finally, the ISGS' success in future endeavors depends on obtaining increased State funding to relieve excessive pressure from grants and contracts, revitalize programs, and initiate new, desirable and needed efforts.

Research Projects in Fiscal Year 1988

15

The map of Illinois, printed on the following two pages, shows counties for which research results were published or where research was in progress during Fiscal Year 1988 (May 1987 to June 1988). For each of the three research groups — Mineral Resources, Environmental Geology, and General and Basic Research — programmatic areas have been identified and numbered in the map's legend.

To obtain complete coverage of the Survey's research and service efforts for the year or additional information about the various research projects being carried out across the state, please write

or call the ISGS (217/333-4747) and request a copy of the Annual Report, which will be supplied free of charge. If you are interested in maps and other publications of the ISGS, request a copy of the "List of Publications," for which there is also no charge.

Please address correspondence to:

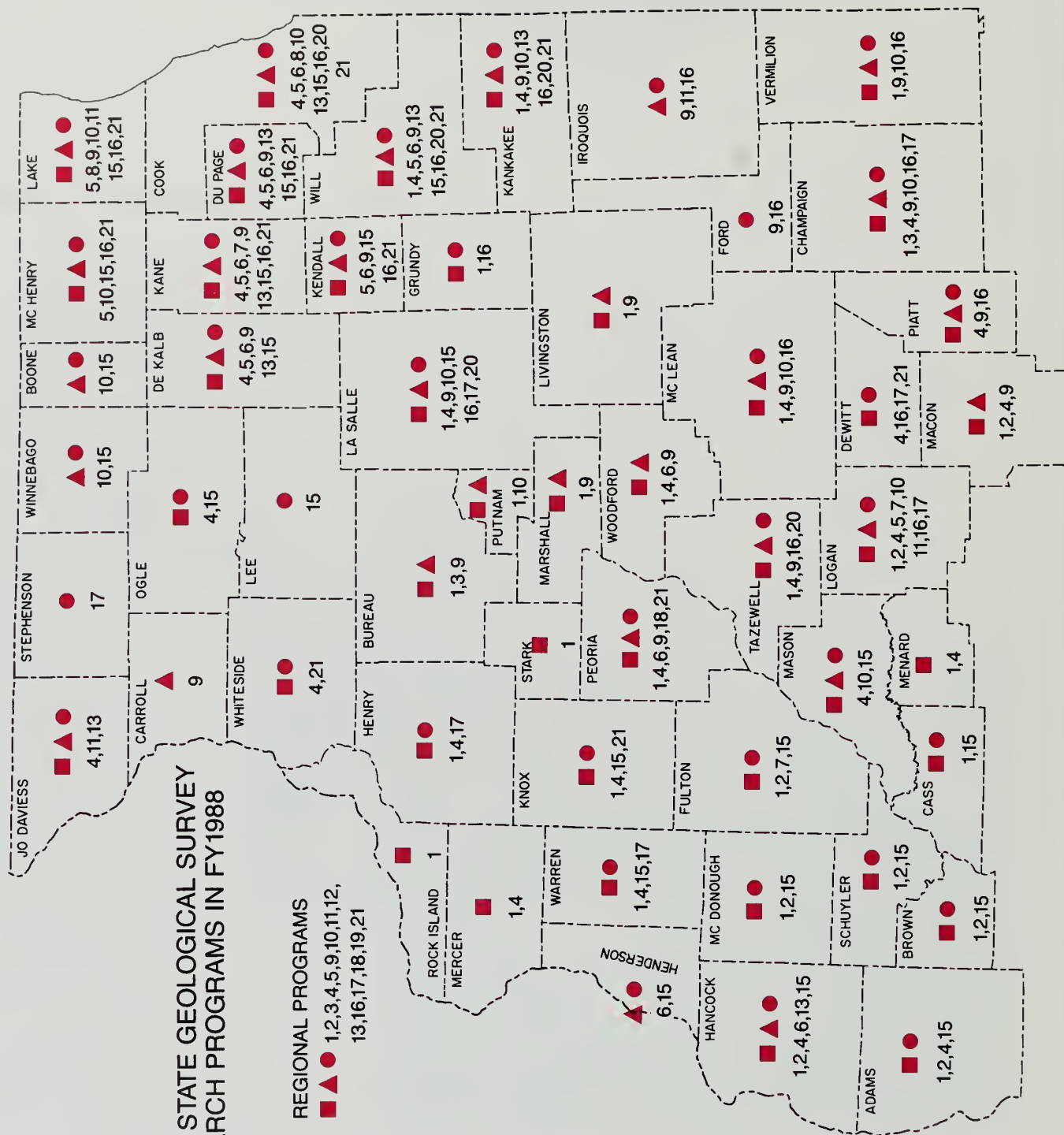
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615 East Peabody Drive
Champaign, Illinois 61820

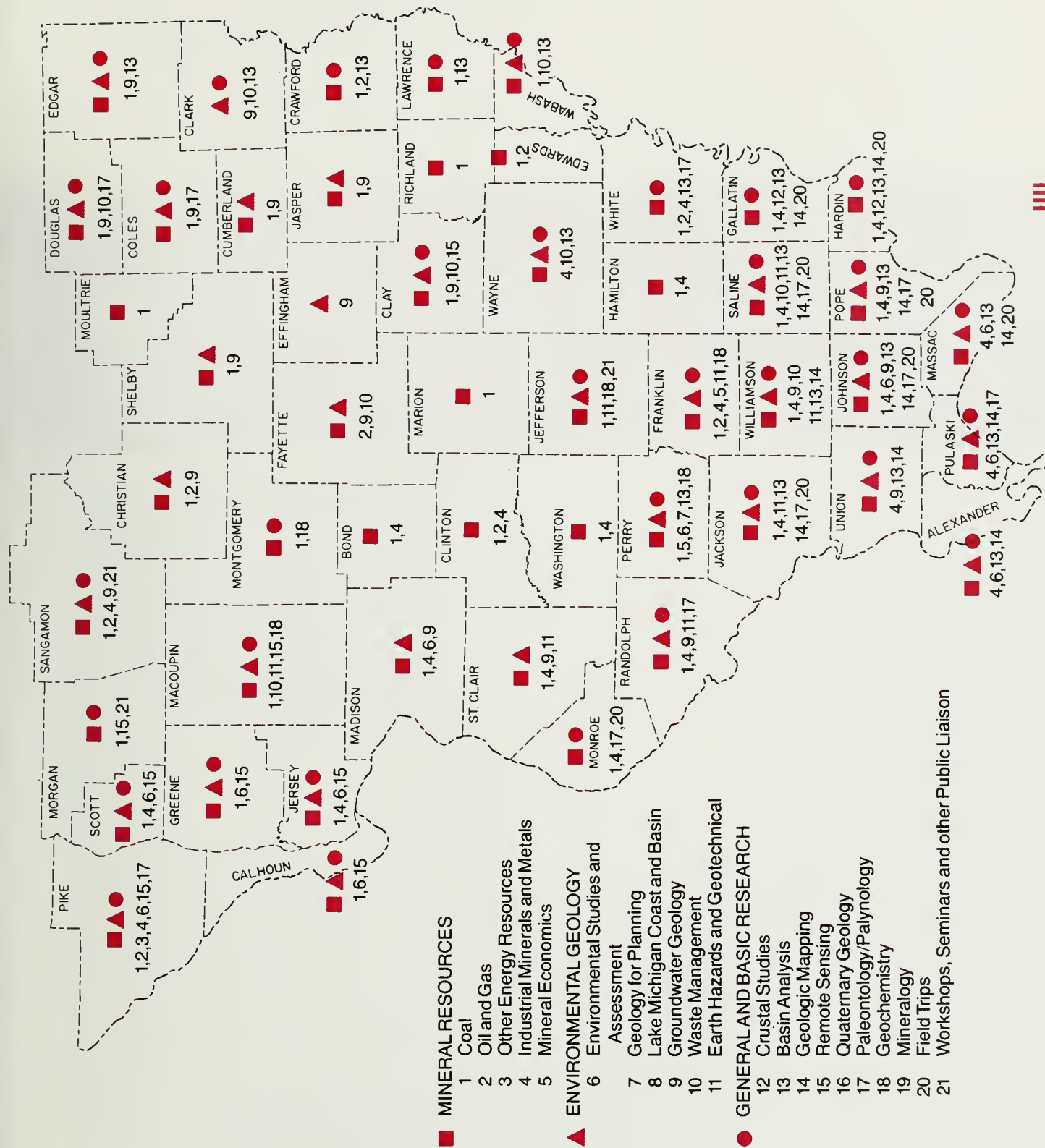


While one geologist measure the attitude of the tilted rock layers of a sandstone formation, the other records the "strike and dip" for geologic mapping purposes. This project is categorized under General and Basic Research, No. 14, for Pope County on the map appearing on the following two pages.

REGIONAL PROGRAMS

■▲● 1,2,3,4,5,9,10,11,12,
13,16,17,18,19,21





This publication is the Survey's look at the year in review, prepared for the first time specifically for the general public. For this reason, it contains historic information, highlights of past and present research and service endeavors, as well as a glimpse of efforts required in the future to answer issues confronting the State...and the Nation. In addition to this document, we continue to publish our complete, technically-oriented Annual Report for the fiscal year.

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